

WHAT IS CLAIMED IS:

1. A field-effect transistor comprising:
a channel layer that is formed on a predetermined
5 semiconductor layer and has an impurity concentration
varying from a low value to a high value; and
a source region and a drain region each having a
bottom face above the predetermined semiconductor layer.
- 10 2. The field-effect transistor as claimed in
claim 1, wherein the impurity concentration varies
linearly or exponentially.
3. The field-effect transistor as claimed in
15 claim 1, wherein the impurity concentration is $1.0 \times 10^{16}/\text{cm}^3$ or higher.
4. The field-effect transistor as claimed in
claim 1, wherein the impurity contained in the channel
20 layer is at least one of selenium, silicon, carbon,
beryllium, and magnesium.
5. A field-effect transistor comprising:
a channel layer that is formed on a predetermined
25 semiconductor layer and has a composition ratio varying
from a low value to a high value; and
a source region and a drain region each having a
bottom face above the predetermined semiconductor layer.
- 30 6. The field-effect transistor as claimed in
claim 5, wherein the channel layer has the composition
ratio of a predetermined material linearly or
exponentially decreasing or increasing as the distance
from the predetermined semiconductor layer increases.
- 35 7. The field-effect transistor as claimed in
claim 5, wherein the predetermined material is at least

one of gallium, indium, aluminum, and antimony.

8. The field-effect transistor as claimed in claim 1, wherein:

5 the predetermined semiconductor layer is a buffer layer that is formed on a semiconductor substrate; and the bottom faces of the source region and the drain region are located within the channel layer.

10 9. A method of producing a field-effect transistor, comprising the steps of:

growing a channel layer on a predetermined semiconductor layer, while varying an impurity concentration from a low value to a high value; and

15 forming a source region and a drain region each having a bottom face above the predetermined semiconductor layer.

20 10. The method as claimed in claim 9, wherein the step of growing a channel layer includes linearly or exponentially increasing the impurity concentration during the growth of the channel layer.

25 11. The method as claimed in claim 9, wherein the step of growing a channel layer includes linearly or exponentially increasing the temperature of an effusion cell for the impurity to be introduced into the channel layer.

30 12. The method as claimed in claim 9, wherein the impurity is at least one of selenium, silicon, carbon, beryllium, and magnesium.

35 13. A method of producing a field-effect transistor, comprising the steps of:

growing a channel layer on a predetermined semiconductor layer, while varying the composition

ratio of a predetermined composition from a low value to a high value; and

forming a source region and a drain region each having a bottom face above the predetermined
5 semiconductor layer.

14. The method as claimed in claim 13, wherein the step of growing a channel layer includes linearly or exponentially increasing or decreasing the flow rate
10 of a gas containing a predetermined organic metal.

15. The method as claimed in claim 14, wherein the predetermined organic metal is trimethylgallium and/or triethylgallium, trimethylindium,
15 trimethylaluminum, or trimethylantimony.

16. The method as claimed in claim 13, wherein the step of growing a channel layer includes linearly or exponentially increasing or decreasing the
20 temperature of an effusion cell for the material that forms the predetermined composition.

17. The method as claimed in claim 13, wherein the predetermined composition is at least one of a
25 gallium composition, an indium composition, an antimony composition, and an aluminum composition.

18. The method as claimed in claim 9, wherein the step of forming a source region and a drain region
30 includes implanting predetermined ions to such a depth that does not reach the predetermined semiconductor layer.